SOUTH DAKOTA STATEWIDE FISHERIES SURVEY
Lake Alvin, Lincoln County
2102-F-21-R-49
2016

Figure 1. Lake Alvin, Lincoln County

Legal Description: T100N-R49W-Sec.33, 34
Location from nearest town: 3 miles east of Harrisburg, SD

Surface Area: 105 acres
Meandered (Y/N): No
OHWM elevation: NA
Outlet elevation: NA
Max. depth at outlet elevation: 26 feet
Observed water level: Full
Contour map available (Y/N): Yes

Watershed area: 24,564 acres
Shoreline length: 4.3 miles
Date set: NA
Date set: NA
Mean depth at outlet elevation: 9 feet
Lake volume: 930 acre feet
Date mapped: 1997

DENR beneficial use classifications: (4) warmwater permanent fish propagation, (7) immersion recreation, (8) limited-contact recreation and (9) fish and wildlife propagation and stock watering

Introduction

General

Lake Alvin is an artificial impoundment formed by the construction of a dam across the lower end of Nine Mile Creek. It was named for Alvin Dempewolf, the only World War 1 soldier from Harrisburg who died overseas. The construction of the dam was completed in August 1954 and the lake completely filled in 1957. The concrete spillway for the dam was replaced in 1994.

Ownership of Lake and Adjacent Lakeshore Properties

Most of the land inundated by and surrounding Lake Alvin is owned and managed by the South Dakota Department of Game, Fish and Parks (GFP). The Parks Division of GFP manages a State Recreation Area surrounding the southeast, east, and northeast corners of the lake as well as a Lake Access Area on the northwest corner of the lake.

Fishing Access

The Lake Alvin Recreation Area on the northeast side of the lake has a single lane boat ramp, boat dock, concrete vault toilet, and parking lot as well as several areas accessible to shore fishing (Figure 1). On the southeast corner of the dam there is a handicapped accessible fishing dock and several additional shore fishing areas. The Southwest Access Area has a public toilet and a narrow boat ramp with a dock suitable for small boats. There is plenty of shoreline to fish but the lake is shallow in this area. The entire lake has been designated as a no-wake zone to protect the shoreline from erosion. At no time can boats exceed 5 mph or produce a visible wake.

Water Quality and Aquatic Vegetation

Water clarity varies considerably from year to year depending on the amount of runoff the lake receives from the watershed (Table 1). The abundance of submerged aquatic vegetation is directly related to water clarity. According to our monthly Secchi readings, overall water clarity was also similar to 2015; however, clarity was low during the survey period due to heavy rains and high runoff (Table 1).

Temperature and dissolved oxygen were monitored for a second year using continuous data loggers. Loggers were deployed on May 12th at depths of 0.5, 1.5, 2.5 and 3.5 meters above the lake bottom (6.5 m or 21.3 ft deep) at the lower end of the reservoir. At the time of deployment, the lake was stratified with low dissolved oxygen at depths greater than 4.5 m (14.8 ft.). Hypoxic conditions in Lake Alvin were less severe in 2016 than 2015 with much of the hypolimnion being periodically re-oxygenated throughout the summer. This occurred even though the difference between surface and bottom temperatures was as great or greater in 2016. Periods of heavy precipitation may have caused these temporary destratifications. Similar to 2015, final destratification occurred in mid-September.

Table 1. Water temperature, Secchi depth and observations/comments on water quality and aquatic vegetation in Lake Alvin, Lincoln County, 2007-2016.

Year	*Water Temp °C (°F)*	*Secchi Depth cm (in)*	*Observations/Comments (algae, aquatic vegetation, water quality, etc.)*
2016	18 (64)	28 (10.5)	Flooded terrestrial plants, cattails
2015	24 (75)	63 (25)	Some sago pondweed and cattails
2014	26 (79)	52 (20)	Some sago pondweed and cattails
2013	27 (81)	97 (38)	Some sago pondweed, cattails
2012	26 (78)	61 (24)	Small beds of sago pondweed, floating-leaf pondweed
2011	21 (69)	41 (15)	Sago pondweed, cattails, floating-leaf pondweed
2010	24 (75)	41 (16)	--
2009	28 (82)	244 (96)	Scattered beds of sago pondweed and cattails
2008	24 (75)	100 (39)	Small beds of sago pondweed, floating-leaf pondweed
2007	26 (79)	325 (128)	Sago pondweed, floating-leaf pondweed, cattails

Fish Community

Lake Alvin contains a very diverse fish community for a relatively small impoundment (Table 2). Many species, like largemouth bass, bluegill and crappie are normally found in small impoundments while river species, like freshwater drum, river carpsucker, gizzard shad and bigmouth buffalo likely entered from the Big Sioux River during extreme flood events.

Table 2. Fish species commonly found in Lake Alvin, Lincoln County.

Game Species	*Other Species*
Largemouth Bass	Common Carp
Black Crappie	Freshwater Drum
Walleye	River Carpsucker
Bluegill	White Sucker
Channel Catfish	Bigmouth Buffalo
White Crappie	Golden Shiner
Black Bullhead	Gizzard Shad
Yellow Bullhead	
Orange-spotted Sunfish	
Green Sunfish	
Northern Pike	
Yellow Perch	

Fish Management

Abundant non-game species compete with game fish for forage and reduce fishing opportunity in Lake Alvin. In addition, poor water quality and resulting lack of abundant aquatic vegetation also limit the fishery. Fish kills have also become more common in recent years (Table 3). Stockings of overwintered juvenile largemouth bass and walleye have been attempted to increase fishing opportunity (Table 4). A pre-spawn, adult gizzard shad stocking was made in 2015 to provide abundant young-of-the-year shad as a source of food for largemouth bass and crappie.

Table 3. Fish kill history for Lake Alvin, Lincoln County.

Year	*Severity*	*Comments*
2010	Light	Minor summer kills of bluegill and crappie
2004	Moderate	Summer kill of crappie and carp on 6/22/04
2003	Light	9/2/03 – bay W of fishing pier – 90 BLG, 7 LMB, 40 WHS
2001	Light	September fish kill, possible fall turnover

Table 4. Stocking history for Lake Alvin, Lincoln County, 2007-2016.

Year	*Number*	*Species*	*Size*
2015	50	Gizzard Shad	Adult
	7,560	Walleye	Fingerling
2014	90,000	Walleye	Fry
2013	1,056	Largemouth Bass	Large Fingerling
	300	Walleye	Adult
2012	259	Largemouth Bass	Adult
2011	2,240	Largemouth Bass	Large Fingerling
2010	1,585	Largemouth Bass	Juvenile
2008	684,610	Fathead Minnow	Adult
2007	430	Walleye	Adult

Methods

Lake Alvin was sampled on June 6-8, 2016 with three overnight gill-net sets and 10 overnight trap-net sets. The gill nets were 45.7 m long x 1.8 m deep (150 ft long x 6 ft deep) with one 7.6 m (25 ft) panel each of 13, 19, 25, 32, 38 and 51-mm-bar-mesh (½, ¾, 1, 1¼, 1½, and 2 in) monofilament netting. The trap nets were constructed with 19-mm-bar-mesh (¾ in) netting, 0.9 m high x 1.5 m wide (3 ft high x 5 ft wide) frames and 18.3 m (60 ft) long leads.

Results and Discussion

Net Catch Results

Black bullheads comprised about 67% of the gill net sample and 78% of the trap net sample (Tables 5, 7). All bullheads sampled in gill nets and trap nets were stock-quality length (15-23 cm, 6-9 in, Table 5). Bigmouth buffalo, freshwater drum, gizzard shad and river carpsucker likely entered the lake from the Big Sioux River during major flood events in 2009, 2011 and 2014 (Table 8).

Table 5. Total catch from three overnight gill nets set in Lake Alvin, Lincoln County, June 6-8, 2016.

Species	*#*	*%*	*CPUE[1]*	*80% C.I.*	*Mean CPUE**	*PSD*	*RSD-P*	*Mean Wr*
Black Bullhead	249	66.9	83.0	±7.5	80.2	0	0	--
Gizzard Shad	40	10.8	13.3	±1.1	4.5	91	0	--
River Carpsucker	31	8.3	10.3	±3.3	4.3	94	68	--
White Sucker	18	4.8	6.0	±3.7	4.0	94	39	--
Channel Catfish	14	3.8	4.7	±1.5	7.6	69	0	89
Freshwater Drum	10	2.7	3.3	±3.6	2.0	--	--	--
Black Crappie	7	1.9	2.3	±1.9	1.1	--	--	--
White Crappie	2	0.5	0.7	±0.9	0.2	--	--	--
Largemouth Bass	1	0.3	0.3	±0.4	0.1	--	--	--

*10 years (2007-2016)

Table 6. CPUE by length category for selected species sampled with gill nets in Lake Alvin, Lincoln County, June 6-8, 2016.

Species	*Substock*	*Stock*	*S-Q*	*Q-P*	*P+*	*All sizes*	*80% C.I.*
Black Bullhead	--	83.0	83.0	--	--	83.0	±7.5
Gizzard Shad	2.0	11.3	1.0	10.3	--	13.3	±1.1
River Carpsucker	--	10.3	0.7	2.7	7.0	10.3	±3.3
White Sucker	--	6.0	0.3	3.3	2.3	6.0	±3.7
Channel Catfish	0.3	4.3	1.3	3.0	--	4.7	±1.5
Freshwater Drum	--	3.3	3.3	--	--	3.3	±3.6
Black Crappie	0.3	2.0	1.7	0.3	--	2.3	±1.9
White Crappie	--	0.7	0.3	--	0.3	0.7	±0.9
Largemouth Bass	--	0.3	0.3	--	--	0.3	±0.4

Length categories can be found in Appendix A.

[1] See Appendix A for definitions of CPUE, PSD, RSD, RSD-P and mean Wr.

Table 7. Total catch from ten overnight trap nets set in Lake Alvin, Lincoln County, June 6-8, 2016.

Species	*#*	*%*	*CPUE*	*80% C.I.*	*Mean CPUE**	*PSD*	*RSD-P*	*Mean Wr*
Black Bullhead	3,219	77.8	321.9	±59.5	136.6	0	0	--
Bluegill	490	11.8	49.0	±29.0	33.3	51	0	95
Black Crappie	172	4.2	17.2	±5.2	41.3	12	2	95
White Sucker	129	3.1	12.9	±6.4	4.9	100	77	--
White Crappie	33	0.8	3.3	±2.2	0.9	55	6	82
Gizzard Shad	22	0.5	2.2	±1.0	0.2	86	0	--
Hybrid Sunfish	22	0.5	2.2	±1.5	0.5	--	--	--
Channel Catfish	18	0.4	1.8	±1.1	3.7	44	0	84
River Carpsucker	9	0.2	0.9	±1.0	0.2	--	--	--
Green Sunfish	8	0.2	0.8	±1.5	0.4	--	--	--
O. S. Sunfish	8	0.2	0.8	±0.6	0.7	--	--	--
Common Carp	2	0.0	0.2	±0.3	0.5	--	--	--
Freshwater Drum	2	0.0	0.2	±0.2	0.2	--	--	--
Bigmouth Buffalo	1	0.0	0.1	±0.1	0.2	--	--	--
Pumpkinseed	1	0.0	0.1	±0.1	0.0	--	--	--
Walleye	1	0.0	0.1	±0.1	0.0	--	--	--
Yellow Perch	1	0.0	0.1	±0.1	0.1	--	--	--

*10 years (2007-2016)

Table 8. CPUE by length category for selected species sampled with trap nets in Lake Alvin, Lincoln County, June 6-8, 2016.

Species	*Substock*	*Stock*	*S-Q*	*Q-P*	*P+*	*All sizes*	*80% C.I.*
Black Bullhead	--	321.9	321.9	--	--	321.9	±59.5
Bluegill	--	49.0	23.8	25.2	--	49.0	±29.0
Black Crappie	--	17.2	15.1	1.7	0.4	17.2	±5.2
White Sucker	--	12.9	--	3.0	9.9	12.9	±6.4
White Crappie	--	3.3	1.5	1.6	0.2	3.3	±2.2
Gizzard Shad	0.1	2.1	0.3	1.8	--	2.2	±1.0
Hybrid Sunfish*	--	--	--	--	--	2.2	±1.5
Channel Catfish	0.2	1.6	0.9	0.7	--	1.8	±1.1
River Carpsucker	--	0.9	--	--	0.9	0.9	±1.0
Green Sunfish	--	0.8	0.5	0.3	--	0.8	±1.5
O. S. Sunfish*	--	--	--	--	--	0.8	±0.6
Common Carp	--	0.2	0.1	--	0.1	0.2	±0.3
Freshwater Drum	--	0.2	0.1	0.1	--	0.2	±0.2
Bigmouth Buffalo	--	0.1	--	0.1	--	0.1	±0.1
Pumpkinseed	--	0.1	0.1	--	--	0.1	±0.1
Walleye	0.1	--	--	--	--	0.1	±0.1
Yellow Perch	--	0.1	0.1	--	--	0.1	±0.1

*No length categories established. Length categories can be found in Appendix A.

Table 9. Gill-net (GN), or trap-net (TN) CPUE for selected fish species sampled in Lake Alvin, Lincoln County, 2007-2016.

Species	*Gear*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
Bigmouth	GN								--	--	--
Buffalo	TN	--	--	--	--	0.6	--	0.2	0.6	0.1	0.1
Black	GN								15.3	142.3	83.0
Bullhead	TN	136.8	39.2	65.7	59.4	31.6	16.5	26.2	535.6	133.1	321.9
Black	GN								--	1.0	2.3
Crappie	TN	32.1	15.9	16.7	183.7	41.0	13.5	44.5	7.0	40.9	17.2
	GN								--	--	--
Bluegill	TN	87.9	26.1	27.5	21.3	6.1	47.5	4.1	3.2	60.5	49.0
Channel	GN								5.3	12.7	4.7
Catfish	TN	1.2	3.1	7.3	8.4	3.1	5.9	2.6	2.0	1.1	1.8
Common	GN								2.3	6.3	--
Carp	TN	--	--	0.1	0.4	1.1	--	0.2	2.6	0.1	0.2
Freshwater	GN								2.0	0.7	3.3
Drum	TN	--	--	0.6	--	0.5	0.4	--	--	0.3	0.2
Gizzard	GN								--	0.3	13.3
Shad	TN	--	--	--	--	--	--	--	--	--	2.2
Golden	GN								--	--	--
Shiner	TN	0.1	--	--	--	--	0.2	0.1	--	0.1	--
Green	GN								--	--	--
Sunfish	TN	0.5	--	0.9	--	--	--	0.2	--	1.5	0.8
Hybrid	GN								--	--	--
Sunfish	TN	0.1	--	0.2	--	--	--	--	--	2.2	2.2
Largemouth	GN								--	--	0.3
Bass	TN	--	--	0.1	--	--	0.2	--	0.1	--	--
Northern	GN								0.7	--	--
Pike	TN	0.1	0.1	0.7	--	0.3	0.1	0.1	0.3	0.1	--
Orange Spotted	GN								--	--	--
Sunfish	TN	4.0	0.2	--	--	--	--	--	0.1	1.4	0.8
Pumpkinseed	GN								--	--	--
Sunfish	TN	--	--	--	--	--	--	0.1	--	--	0.1
River	GN								1.3	1.3	10.3
Carpsucker	TN	--	--	--	--	0.2	0.1	--	0.3	0.2	0.9
	GN								--	0.3	--
Walleye	TN	--	--	--	--	--	--	--	--	--	0.1
White	GN								--	--	0.7
Crappie	TN	0.3	0.2	0.1	0.8	--	0.2	0.1	0.8	3.6	3.3
White	GN								2.0	4.0	6.0
Sucker	TN	4.5	7.1	2.6	4.3	6.7	3.3	1.0	3.5	3.1	12.9
Yellow	GN								--	--	--
Perch	TN	0.2	--	0.2	--	--	--	--	0.2	--	0.1

Black Crappie

Management Objective

- Maintain a black crappie population with a total trap-net CPUE of 20-30 and PSD of at least 40.

Management Strategies

- Black crappie growth and maximum size is reduced when population densities become too high. Consider reducing population densities when trap-net CPUE exceeds 30 for more than two years.
- Black crappies seldom exceed 25 cm (10 in) in Lake Alvin. Consider an experimental stocking of gizzard shad to provide supplemental forage.

Trap-net CPUE decreased from 2015 and is now slightly below the objective range (Table 10). The majority of crappies sampled were age-2+ and age-3+; however, some age-4+ and age-5+ fish averaging over 25 cm (10 in) were also sampled (Table 10). These were the largest fish sampled in the past 10 years. Black crappie growth seems to have improved possibly due to their relatively low abundance and gizzard shad forage.

Table 10. CPUE, PSD, RSD-P, and mean Wr for all black crappie sampled with trap nets in Lake Alvin, Lincoln County, 2007-2016. Years in which the management objective was achieved or nearly achieved are shaded.

	2007	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***
CPUE	32.1	15.9	16.7	183.7	41.0	13.5	44.5	7.0	40.9	17.2
PSD	3	13	38	1	68	53	6	77	8	12
RSD-23	1	0	5	0	0	16	1	5	3	3
RSD-P	0	0	0	0	0	1	0	2	0	2
Mean Wr	102	102	110	110	102	103	108	93	99	95

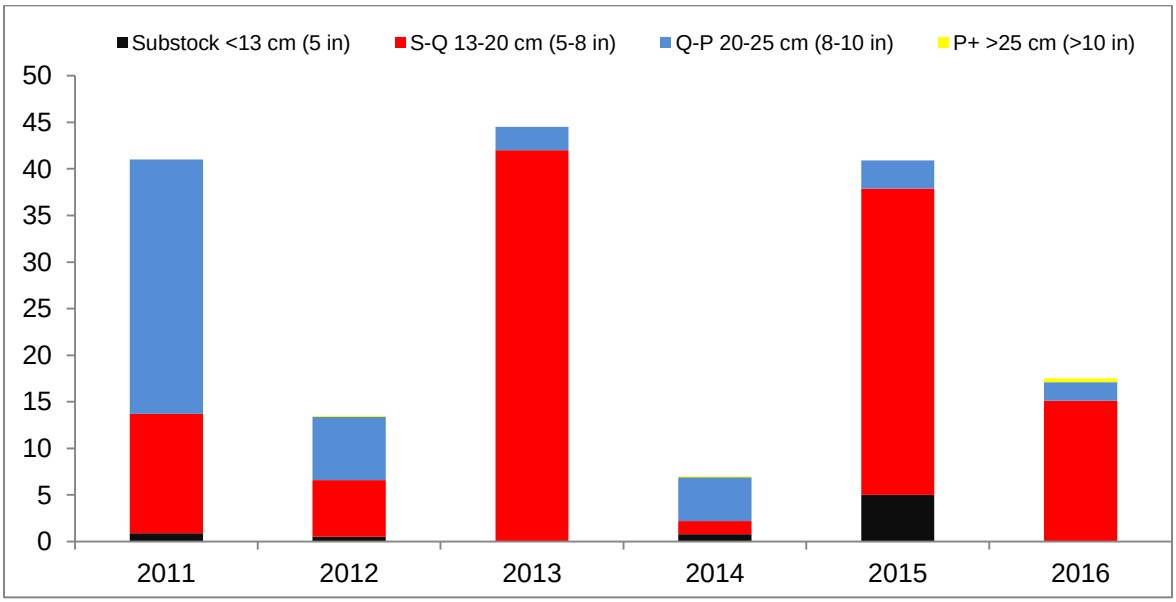

Figure 2. CPUE by length category for black crappie sampled with trap nets in Lake Alvin, Lincoln County, 2011-2016.

Table 11. Weighted mean length at capture (mm) for black crappie sampled with trap nets in Lake Alvin, Lincoln County, 2007-2016. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends. Sample size is in parentheses.

Year	*Age-1*	*Age-2*	*Age-3*	*Age-4*	*Age-5*	*Age-6*	*Age-7*	*Age-8*	*Age-9*	*Age-10*
2016	--	163 (85)	194 (81)	258 (5)	253 (2)					
2015	124 (70)	176 (316)	224 (23)	--	--	--	--	--	--	--
2014	125 (11)	207 (56)	--	248 (2)	239 (1)	--	--	--	--	--
2013	--	174 (420)	212 (4)	228 (17)	227 (4)	--	--	--	--	--
2012	87 (44)	154 (24)	204 (3)	217 (42)	220 (21)	--	317 (1)	--	--	--
2011	120 (13)	198 (159)	209 (237)	--	--	--	--	--	--	--
2010	130 (19)	177 (1819)	--	--	--	--	--	--	--	--
2009	118 (154)	189 (4)	215 (3)	224 (6)	192 (1)	--	--	--	--	--
2008	119 (22)	158 (61)	189 (58)	205 (4)	195 (18)	--	--	--	--	--
2007	109 (4)	179 (307)	205 (7)	222 (5)	220 (2)	--	--	--	--	--

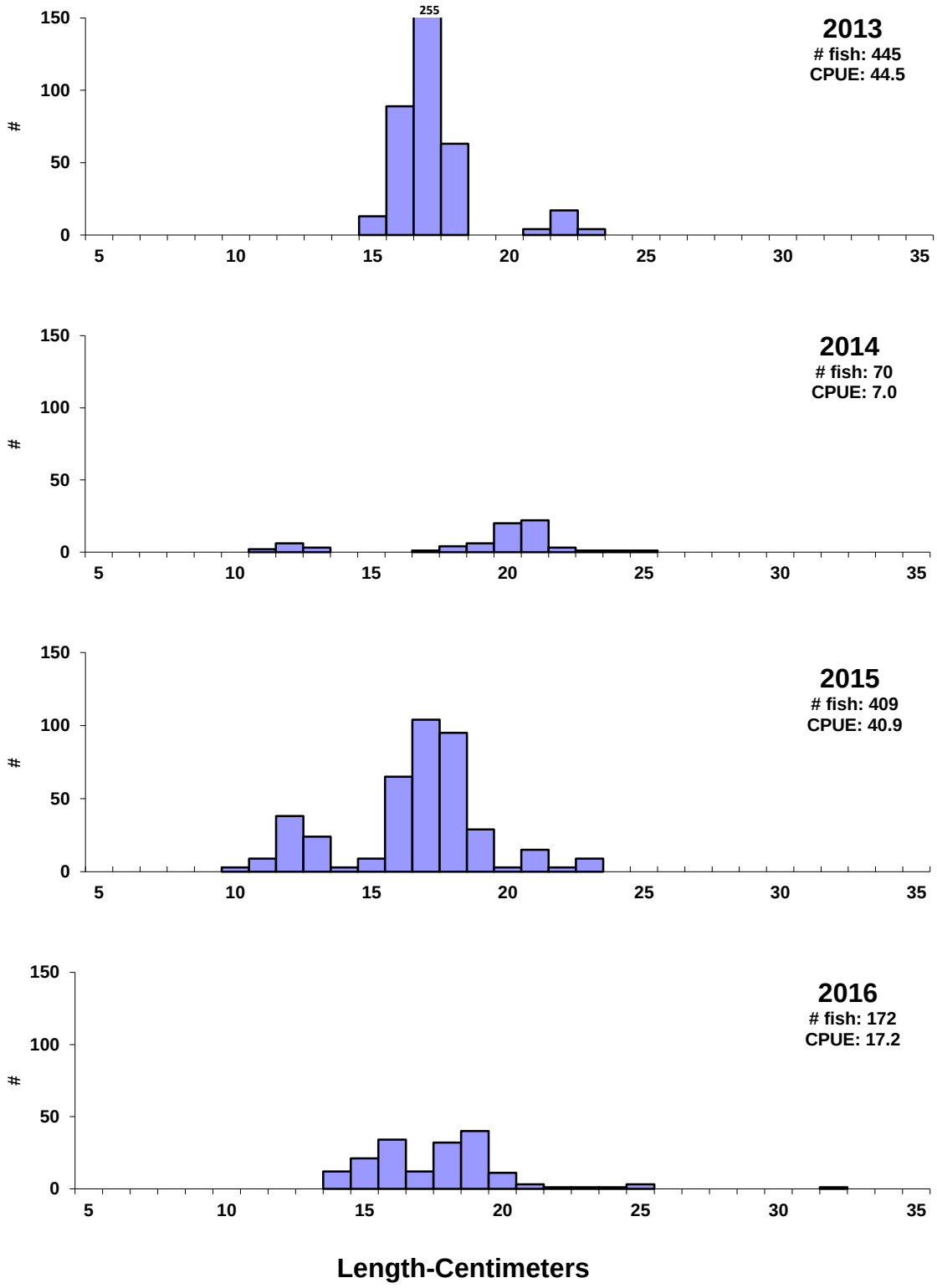

Figure 3. Length frequency histograms for black crappies sampled with trap nets in Lake Alvin, Lincoln County, 2013, 2014, 2015, 2016.

Bluegill

Management Objective

- Maintain a bluegill population with a total trap-net CPUE of 25-50 and RSD-18 of at least 20.

Management Strategy

- Bluegill growth and maximum size is reduced when population densities become too high. Consider reducing population densities when trap-net CPUE exceeds 50 for more than two years.

Bluegill abundance in 2016 was similar to 2015 (Table 12). Growth slows down after bluegill reach age-4, and few fish attain a length of 20 cm (8 in; Figure 4, Table 13).

Gizzard shad have survived the winters in Lake Alvin much better than expected. As a result, they have become very abundant and there is concern about their effect on the bluegill population. The high abundance of gizzard shad has also coincided with a severe decline in overall zooplankton density. Since zooplankton is important forage for bluegill, the decreased density could have a negative impact on growth and abundance.

Table 12. CPUE, PSD, RSD-P, and mean Wr for all bluegills sampled with trap nets in Lake Alvin, Lincoln County, 2006-2015. Years in which the management objective was achieved or nearly achieved are shaded.

	2007	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***
CPUE	87.9	26.1	27.5	21.3	6.1	47.5	4.1	3.2	60.5	49.0
PSD	37	88	84	61	89	73	34	78	34	51
RSD-18	3	8	62	19	8	44	0	7	2	1
RSD-P	0	0	3	4	3	3	0	3	0	0
Mean Wr	91	99	110	91	95	97	104	100	94	95

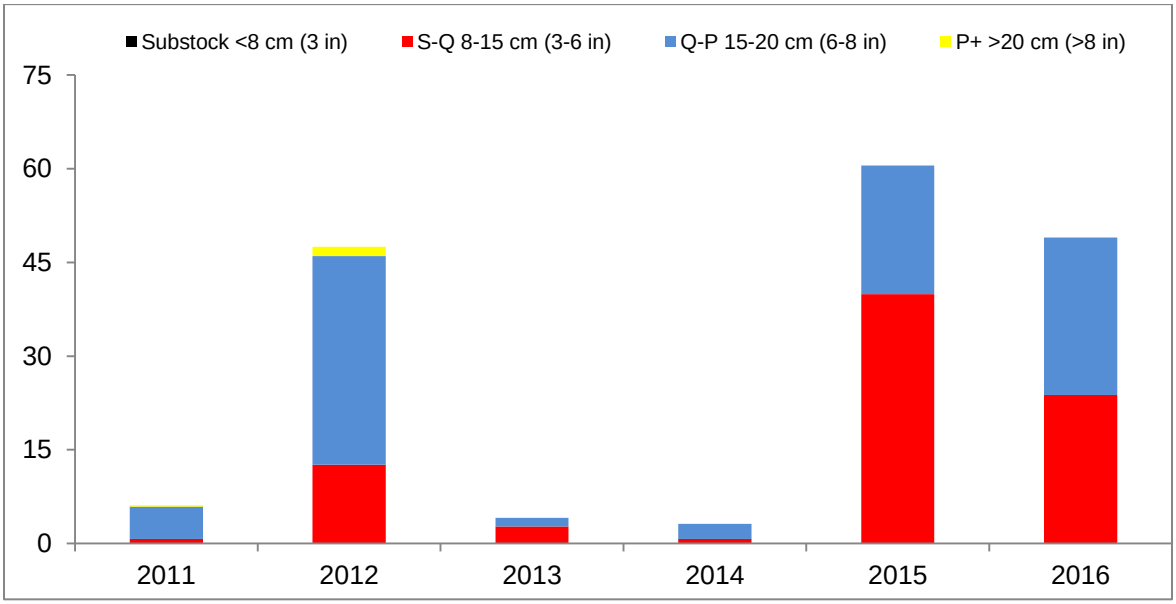

Figure 4. CPUE by length category for bluegills sampled with trap nets in Lake Alvin, Lincoln County, 2011-2016.

Table 13. Weighted mean length at capture (mm) for bluegills sampled with trap nets in Lake Alvin, Lincoln County, 2006-2015. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends. Sample size is in parentheses.

Year	*Age-1*	*Age-2*	*Age-3*	*Age-4*	*Age-5*	*Age-6*	*Age-7*	*Age-8*	*Age-9*	*Age-10*
2015	--	137 (378)	155 (154)	172 (59)	178 (15)	--	--	--	--	--
2014	97 (4)	150 (7)	168 (16)	176 (4)	207 (1)	--	--	--	--	--
2013	--	141 (35)	157 (6)	--	--	--	---	--	--	--
2012	71 (119)	123 (100)	154 (38)	175 (111)	180 (102)	210 (5)	--	--	--	--
2011	--	138 (6)	166 (52)	191 (1)	--	205 (2)	--	--	--	--
2010	--	149 (165)	181 (8)	189 (10)	190 (29)	201 (2)	--	--	--	--
2009	114 (8)	133 (31)	173 (13)	183 (167)	194 (36)	173 (8)	--	--	--	--
2008	--	135 (5)	155 (44)	163 (168)	174 (9)	193 (8)	--	--	--	--
2007	--	133 (325)	149 (400)	160 (123)	178 (21)	184 (9)	--	--	--	--
2006	119 (50)	138 (204)	160 (43)	164 (77)	170 (91)	181 (10)	--	--	--	--

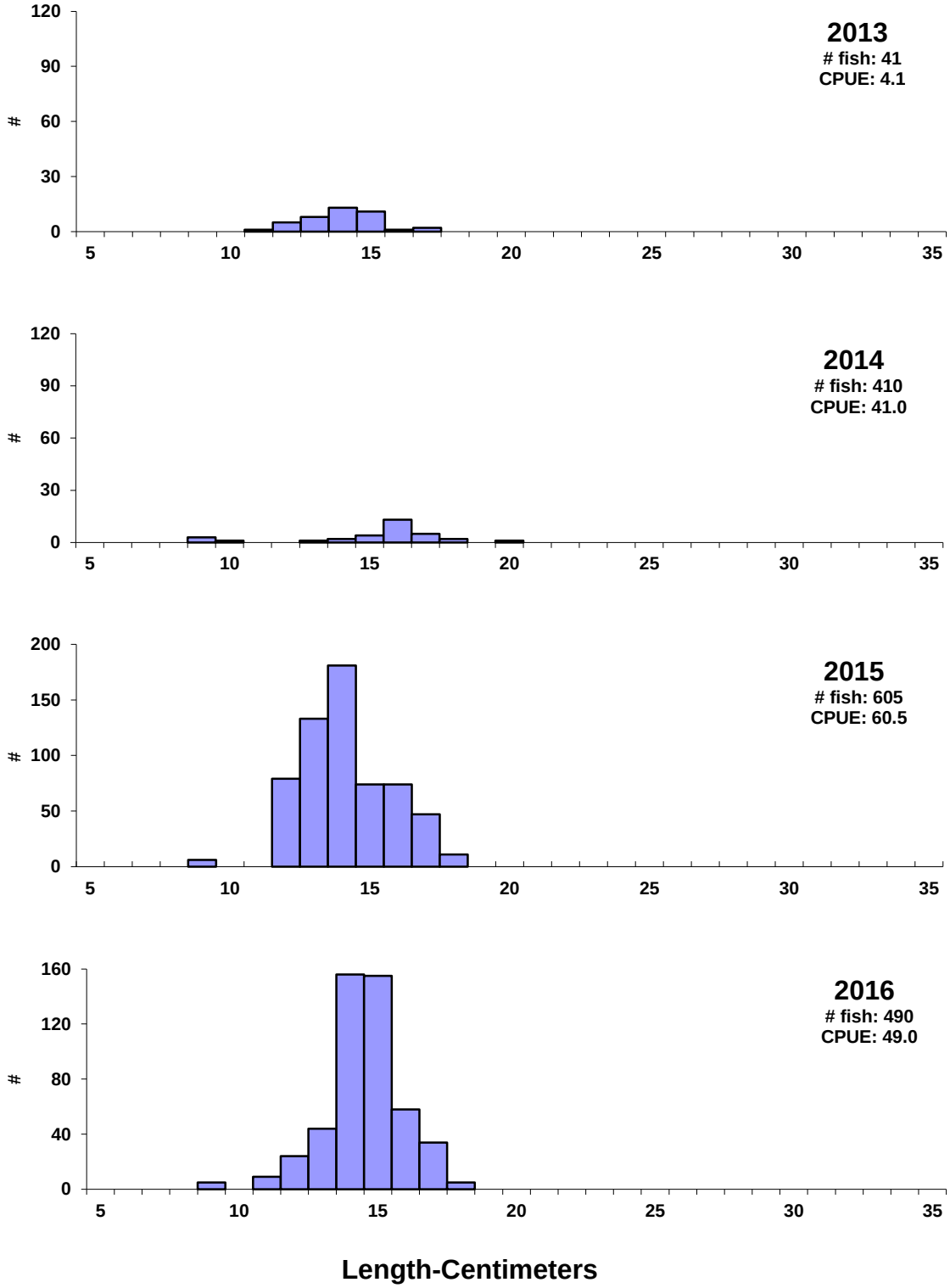

Figure 5. Length frequency histograms for bluegills sampled with trap nets in Lake Alvin, Lincoln County, 2013, 2014, 2015, 2016.

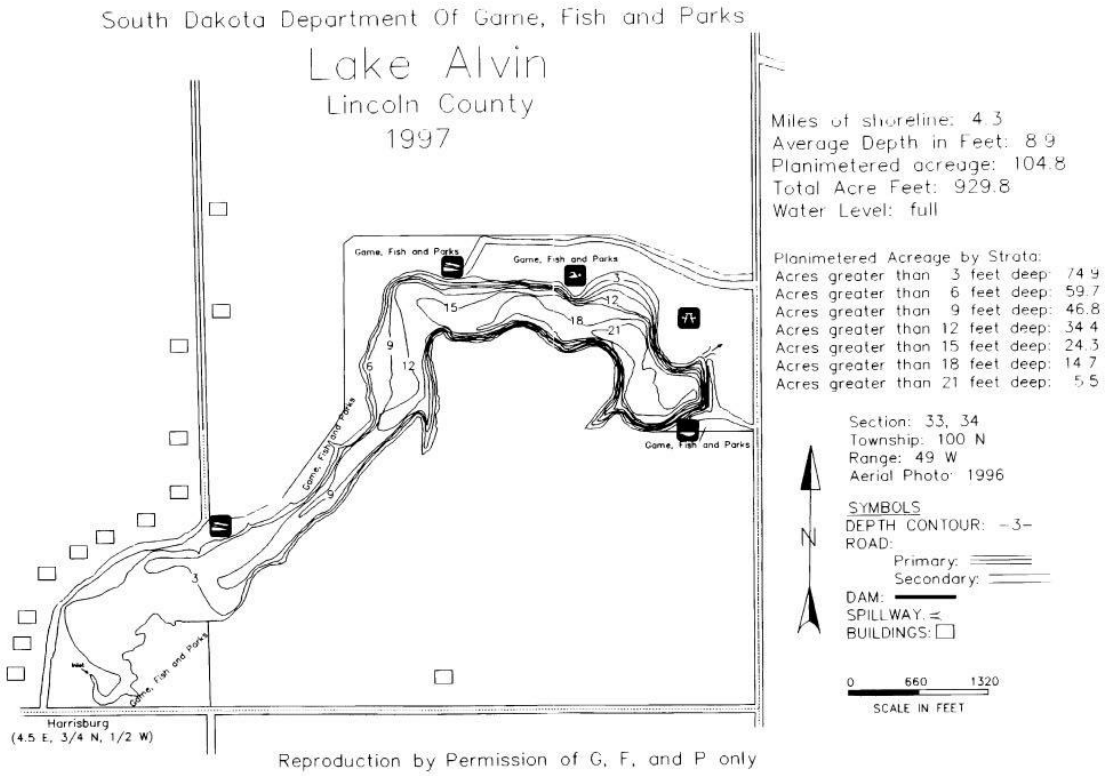

Figure 6. Contour map of Lake Alvin, Lincoln County.

Appendix A. A brief explanation of catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr).

Catch per Unit Effort (CPUE) is the catch of animals in numbers or in weight taken by a defined period of effort. Can refer to trap-net nights of effort, gill net nights of effort, catch per hour of electrofishing, etc.

Proportional Stock Density (PSD) is calculated by the following formula:

$$PSD = \frac{\text{Number of fish} > \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

Relative Stock Density (RSD-P) is calculated by the following formula:

$$RSD\text{-}P = \frac{\text{Number of fish} > \text{preferred length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

PSD and RSD-P are unitless and usually calculated to the nearest whole digit.

Size categories for selected species found in Region 3 lake surveys, in centimeters (Inches in parenthesis).

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	25 (10)	38 (15)	51 (20)	63 (25)	76 (30)
Yellow perch	13 (5)	20 (8)	25 (10)	30 (12)	38 (15)
Black crappie	13 (5)	20 (8)	25(10)	30 (12)	38 (15)
White crappie	13 (5)	20 (8)	25(10)	30 (12)	38 (15)
Bluegill	8 (3)	15 (6)	20 (8)	25 (10)	30 (12)
Largemouth bass	20 (8)	30 (12)	38 (15)	51 (20)	63 (25)
Smallmouth bass	18 (7)	28 (11)	35(14)	43 (17)	51 (20)
Northern pike	35 (14)	53 (21)	71 (28)	86 (34)	112 (44)
Channel catfish	28 (11)	41 (16)	61 (24)	71 (28)	91 (36)
Black bullhead	15 (6)	23 (9)	30 (12)	38 (15)	46 (18)
Common carp	28 (11)	41 (16)	53 (21)	66 (26)	84 (33)
Bigmouth buffalo	28 (11)	41 (16)	53 (21)	66 (26)	84 (33)

For most fish, 30-60 or 40-70 are typical objective ranges for “balanced” populations. Values less than the objective range indicate a population dominated by small fish while values greater than the objective range indicate a population comprised mainly of large fish.

Relative weight (Wr) is a condition index that quantifies fish condition (i.e., how much does a fish weigh for its length). A Wr range of 90-100 is a typical objective for most fish species. When mean Wr values are well below 100 for a size group, problems may exist in food and feeding relationships. When mean Wr values are well above 100 for a size group, fish may not be making the best use of available prey.